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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/086,620	02/28/2002	David B. Buehler	1027.2.1	1888

7590   11/26/2003

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EXAMINER
NGUYEN, KIMBINH T

ART UNIT	PAPER NUMBER
2671	3

DATE MAILED: 11/26/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 February 2002*.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

    a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *2*.

4)☐ Interview Summary (PTO-413) Paper No(s). _____.

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: .

DETAILED ACTION

1.   Claims 1-24 are pending in the application.

Claim Rejections - 35 USC § 103

2.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

3.   Claims 1-5, 13, 15, 20 and 21 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Kaufman et al. (5,442,733).

Claim 1, Kaufman et al. teaches a method of recursive ray casting (col. 1, lines

12-20), the method comprising: providing a ray bundle (family of rays) of a selected

position, direction(col. 9, lines 57-65) and size (varying sizes to suit the features of the

scene; col. 1, lines 67-68); conducting a proximity test of a selected proximity at the

selected position (col. 18, lines 36-41); and advancing the ray bundle a first casting

distance (short distance) when the proximity test is negative (opaque), col. 12, lines 55-

65). Kaufman does not teach advancing the ray bundle a first casting distance (short

distance) when the proximity test is negative; however, Kaufman teaches depending the

size of the cubic frame buffer, the voxels move in either negative or positive direction

along any axis (col. 11, lines 10-12). Therefore, it would have been obvious to one of

ordinary skill in the art at the time the invention was made to utilize the proximate test

for provide advancing ray casting distance, because it would improve performance when tracing scene of higher complexity (col. 12, lines 60-65).

Claims 2, 3, Kaufman et al. discloses the first casting distance corresponds to the selected proximity; the size of the ray bundle corresponds to the selected proximity (col. 13, line 56 through col. 14, line 2). **Claims 4, 5**: advancing a second casting distance when the proximity test is positive, retreating a second casting distance when the proximity test is positive (col. 11, lines 7-10). **Claim 13**: accessing a list of proximate objects (proximity indicator; col. 18, lines 36-41).

Claim 15, the rationale provided in the rejection of claim 1 is incorporated herein.

Claims 20, 21, Kaufman et al. teaches a collision tester configured to receive a ray position and provide a second hit signal indicating whether the ray position to is on or within the graphical object (traversing sight ray) (abstract); a ray caster configured to advance the ray position (col. 15, lines 56-67).

4.   Claims 6-10, 12, 14, 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kaufman et al. (5,442,733) in view of Lathrop (6,597,359).

Claims 6-10, Lathrop teaches subdividing the ray bundle into child bundles when the proximity test is positive (col. 2, lines 52-57); traversing and subdividing until each child bundle is a single ray (col. 3, lines 8-43); partitioning along the largest ray bundle dimension (complex object or root address); partitioning along each ray bundle dimension; combining child bundles(leaf) of a subdivided ray bundle when the proximity test of the ray bundle is negative (empty; col. 7, lines 63-67). **Claim 12**, Lathrop teaches accessing a distance grid (x distance; col. 15, lines 52-67). **Claim 17**, Lathrop teaches

the pixel set is defined by an area selected from a scan line span, a rectangle, and a

triangle (col. 14, line 65 through col. 15, line 20). It would have been obvious to one of

ordinary skill in the art at the time the invention was made to incorporate the subdivision

hardware for ray tracing as taught by Lathrop into the ray tracing of Kaufman, because

performing the hierarchical space subdivision technique, it would provide fast and

accurate image rendering (col. 3, lines 66-67).

Claim 14. the rationale provided in the rejection of claims 1-7 is incorporated

herein.

5.   Claims 11 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable

over Kaufman et al. (5,442,733) in view of Jennings, III (6,430,589).

Claim 11 and 19, Jennings, III teaches testing Boolean flags (fig. 8); the bundle

caster comprises at least one register file, each register file thereof coupled to an ALU

(col. 15, lines 16-24). It would have been obvious to one of ordinary skill in the art at the

time the invention was made to incorporate the testing flag as taught by Jennings, III

into the ray tracing of Kaufman ,because it would provide an arithmetic engine for video

frame rendering (col. 6, lines 57-60).

6.   Claims 16, 18, 23 and 24 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Kaufman et al. (5,442,733) in view of Sowizral et al. (6,445,391) and

Greene et al. (5,579,455).

Claim 16. Sowizral et al. an occlusion detector operably connected to the bundle

caster (software occlusion culling; col. 1, lines 56-67), the occlusion detector configured

to receive a pixel set descriptor and a minimum z-depth. Sowizral does not teach z-min;

however, Greene et al. teaches x-min values is the nearest depth value in the covering

depth element (col. 17, lines 36-40). It would have been obvious to one of ordinary skill

in the art at the time the invention was made to incorporate the z buffer as taught by

Greene into occlusion detector of Sowizral for providing the finest level in the covering

depth element, because using z-min elements, it would permit a possible definitive

determination of visibility (col. 17, lines 21-23). **Claim 18,** Sowizral teaches the

occlusion detector is configured to operate at a lower depth resolution than the bundle

caster (fig. 6).

Claims 23 and 24, Greene et al. teaches ray casting connects to occlusion, the

occlusion detector comprises: a z-buffer configured to store an occlusion depth for each

of a plurality of pixels (col. 3, lines 56-61), the occlusion depth being a low resolution

representation of pixel depth (z pyramid; col. 3, lines 61-67; col. 5, lines 45-67); a

register configured to receive a pixel set descriptor describing a set of pixels including a

minimum depth for the set ; and a comparator configured to access the z-buffer and

compare the minimum depth with the occlusion depth for each pixel within the set of

pixels (col. 10, lines 45-67). It would have been obvious to one of ordinary skill in the art

at the time the invention was made to incorporate the z buffer as taught by green into

the ray caster of Kaufman, because using ray casting and z buffering, it would improve

visibility algorithm in order to significantly speed up the rendering of 3D scenes (col. 3,

lines 49-52).

7.   Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Kimbinh Nguyen** whose telephone number is **(703) 305-9683**. The examiner can normally be reached **(Monday- Thursday from 7:00 AM to 4:30 PM and alternate Fridays from 7:00 AM to 3:30 PM)**.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Zimmerman, can be reached at (703) 305-9798.

Any response to this action should be mailed to:

Commissioner of Patents and Trademarks
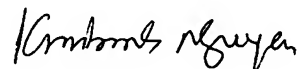
Washington, D.C. 20231

Or faxed to:

(703) 872-9314 (for Technology Center 2600 only)

Hand-delivered responses should be brought to Crystal Part II, 2121 Crystal Drive, Arlington, VA, Sixth Floor (Receptionist).

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center 2600 Customer Service Office whose telephone number is (703) 306-0377.

November 25, 2003

Kimbinh Nguyen

Patent Examiner AU 2671